

# A 10kWatt 36GHz Solid-State Power Amplifier using GaN-on-Diamond, Phase I

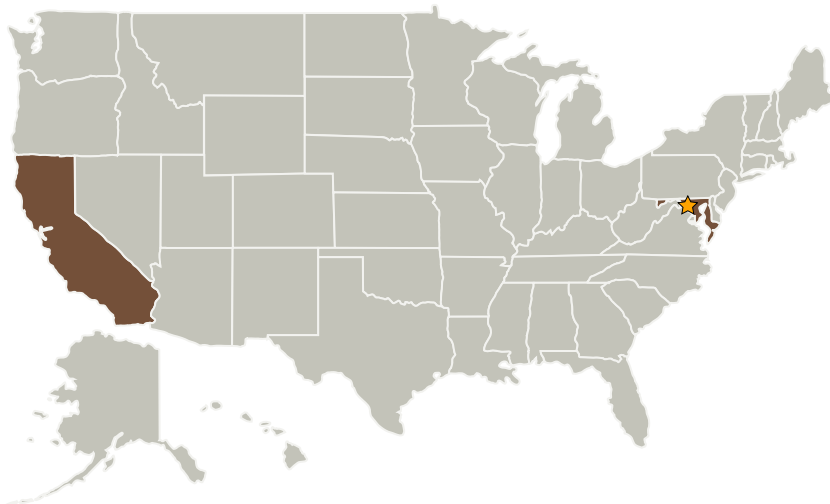
Completed Technology Project (2009 - 2009)



## Project Introduction

This Phase-I SBIR proposal proposes for the first time ever, the use of a new class of materials - Gallium Nitride-on-diamond - in the manufacture of very high power, high-temperature, Ka-band solid-state MMICs. In this particular Phase-I, the first ever 34-38GHz GaN-on-Diamond FETs will be demonstrated, exhibiting a record 5-10 W/mm at record efficiency and temperature levels. Arrays of these FETs will be used to form 10KWatt Power Amplifiers (PA) MMICs in Phase-II. Polycrystalline free standing CVD diamond -- nature's most efficient thermal conductor -- enables nearly perfect heat extraction from a "hot" device (Thermal conductivities of GaAs, Si, and SiC are 35W/m/K, 150W/m/K and 390W/m/K respectively; diamond ranges from 1200-2000 W/m/K depending on quality). In the proposed scheme, the device's active epitaxial layers are removed from their original host substrate and transferred to a specially treated low-cost CVD diamond substrate using a proprietary low-cost manufacturable scheme. The active junction rests just 20-nm from diamond. The semiconductor-on-diamond technology proposed here may be applied to GaAs, SiC, SiGe, etc. at up to 8" in wafer diameter.

## Primary U.S. Work Locations and Key Partners



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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Goddard Space Flight Center (GSFC)

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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| Organizations Performing Work      | Role                    | Type        | Location               |
|------------------------------------|-------------------------|-------------|------------------------|
| ★Goddard Space Flight Center(GSFC) | Lead Organization       | NASA Center | Greenbelt, Maryland    |
| Group4 Labs, LLC                   | Supporting Organization | Industry    | Menlo Park, California |

## Primary U.S. Work Locations

|            |          |
|------------|----------|
| California | Maryland |
|------------|----------|

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

## Technology Areas

**Primary:**

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - └ TX05.2 Radio Frequency
    - └ TX05.2.2 Power-Efficiency